

1 **Amendment to the Claims**

2 **In the Claims:**

3 Please cancel Claim 37 and amend Claims 1, 20, 28, 38, 39, and 43 as follows:

4 1. (Currently Amended) Apparatus for display of an image, in regard to a limited region of
5 interest, comprising:

6 (a) a light source which emits light;
7 (b) a substrate that serves as a support;
8 (c) a cantilever comprising a fixed end and a free end, the fixed end remaining
9 fixed to the substrate and the free end extending freely relative to the substrate, enabling the free end
10 to bend and deflect in regard to the limited region of interest ~~to scan~~, the bending of the cantilever
11 scanning light onto an image plane to create an image, wherein the cantilever is configured as one of:

12 (i) a waveguide that conveys light from the light source within the
13 cantilever, when scanning the light onto the image plane to create the image; and

14 (ii) a moving carrier for the light source that emits the light, the light
15 source being mounted on the free end of the cantilever and moving when scanning the light emitted
16 by the light source onto the image plane to create the image;

17 (d) an actuator disposed adjacent to the cantilever and being employed for
18 deflecting the cantilever so as to move the free end to scan in a desired motion; ~~and~~

19 (e) a photon detector configured to receive light at a location that is proximate to
20 the cantilever and to the support; and

21 (f) a position sensor employed for detecting a position of the free end of the
22 cantilever, for producing a signal used in controlling the actuator to cause the cantilever to move in
23 the desired motion.

24 2. (Original) The apparatus of Claim 1, wherein the apparatus has at least two dimensions
25 smaller than three millimeters.

26 3. (Original) The apparatus of Claim 1, wherein the light source provides the light using at
27 least one of a diode, a laser, and an optical fiber.

28 4. (Original) The apparatus of Claim 1, wherein the light source is one of:

- 29 (a) end-buttet to the fixed end of the cantilever; and
30 (b) attached adjacent to the free end of the cantilever.

1 5. (Original) The apparatus of Claim 1, wherein the cantilever comprises at least one of a
2 silicon oxide, a silicon nitride, a glass, a polymer, a photoresist, and an epoxy resin.

3 6. (Original) The apparatus of Claim 1, wherein the cantilever is tapered in at least one
4 dimension such that the fixed end is larger than the free end in said at least one dimension.

5 7. (Original) The apparatus of Claim 1, wherein a dimension of the cantilever varies from the
6 fixed end to the free end to determine vibrational characteristics of the cantilever.

7 8. (Original) The apparatus of Claim 1, wherein the cantilever is formed by at least one of a
8 deep reactive ion etching, a photolithography, an e-beam lithography and a wet anisotropic etching of
9 the substrate using a mask to define a shape of the cantilever.

10 9. (Canceled)

11 10. (Previously Presented) The apparatus of Claim 1, wherein the cantilever is one of:

- 12 (a) deflected into a resonant motion in at least one of two directions;
13 (b) deflected into a non-resonant motion in at least one of the two directions;
14 (c) deflected into two-dimensional circular motion using a single actuator;
15 (d) deflected into two-dimensional rocking linear motion using single actuator;

16 and

- 17 (e) deflected so as to selectively move the free end to a desired position.

18 11. (Original) The apparatus of Claim 1, wherein the actuator comprises one of an
19 electrostatic force actuator, a piezoelectric actuator, and an electromagnetic actuator.

20 12. (Original) The apparatus of Claim 1, wherein the actuator comprises at least one of:

21 (a) an actuator for deflecting the cantilever in a vertical direction relative to a primary
22 plane of the substrate; and

23 (b) an actuator for deflecting the cantilever in a horizontal direction relative to the primary
24 plane of the substrate.

25 13. (Original) The apparatus of Claim 1, wherein the actuator is attached to at least one of:

- 26 (a) the cantilever; and
27 (b) the substrate.

28 ///

29 ///

30 ///

1 14. (Previously Presented) The apparatus of Claim 1, wherein the position sensor comprises
2 one of:

- 3 (a) the actuator;
- 4 (b) a piezoelectric transducer;
- 5 (c) a capacitive displacement transducer;
- 6 (d) a piezoresistive sensor;
- 7 (e) a light source and detector pair;
- 8 (f) a photodetector array;
- 9 (g) a magnetic sensor;
- 10 (h) a fiber bundle displacement sensor;
- 11 (i) an interferometer; and
- 12 (j) an inductive displacement transducer.

13 15. (Original) The apparatus of Claim 1, further comprising a lens disposed at the free end of
14 the cantilever through which the light conveyed through the cantilever passes.

15 16. (Original) The apparatus of Claim 15, wherein the lens comprises one of a focusing lens,
16 a refractive lens, and a diffractive lens.

17 17. (Original) The apparatus of Claim 15, wherein the free end of the cantilever comprises a
18 gradient index lens.

19 18. (Original) The apparatus of Claim 1, wherein the light source comprises:

- 20 (a) a white light source; and
- 21 (b) a tunable color filter to provide precise color spectrum of light, the tunable
22 color filter comprising one of:
 - 23 (i) an optical resonant cavity;
 - 24 (ii) a grating; and
 - 25 (iii) a prism.

26 19. (Original) The apparatus of Claim 1, wherein the light source comprises a plurality of
27 color elements, each of the plurality of color elements producing a different color light.

28 ///

29 ///

30 ///

1 20. (Currently Amended) Apparatus for use either for a far-field image acquisition or for a
2 display of an image, in regard to a limited region of interest comprising a target, wherein the
3 apparatus is configured as a micro-electro-mechanical system (MEMS), the apparatus comprising:

4 (a) a light source, which emits light;
5 (b) a substrate that serves as a support;
6 (c) a cantilever comprising at least one of a thin film layer and a thick film layer
7 and having a fixed end and a free end, the fixed end remaining fixed to the substrate upon which the
8 cantilever was originally formed and the free end extending freely beyond where the substrate has
9 been removed from supporting the cantilever, enabling the free end to bend and deflect relative to the
10 substrate ~~in~~ and the limited region of interest, for scanning with the free end of the cantilever relative
11 to the target;

12 (d) an actuator disposed adjacent to the cantilever, the actuator being employed for
13 bending and deflecting the cantilever so as to move the free end in a desired motion, to scan at least a
14 portion of the limited region of interest; ~~and~~

15 (e) a photon detector configured to receive light at a location that is proximate to
16 the cantilever and to the support; and

17 (f) a position sensor employed for detecting a position of the free end of the
18 cantilever, for producing a signal used in controlling the actuator to cause the cantilever to move in
19 the desired motion.

20 21. (Original) The apparatus of Claim 20, wherein the apparatus has at least two dimensions
21 smaller than three millimeters.

22 22. (Previously Presented) The apparatus of Claim 20, wherein the light source provides the
23 light using at least one of a diode, a laser, and an optical fiber.

24 23. (Original) The apparatus of Claim 20, wherein the light source is one of:

- 25 (a) end-buttetd to the fixed end of the cantilever; and
26 (b) attached adjacent to the free end of the cantilever.

27 24. (Original) The apparatus of Claim 20, wherein the cantilever comprises at least one of a
28 silicon oxide, a silicon nitride, a glass, a polymer, a photoresist, and an epoxy resin.

29 25. (Original) The apparatus of Claim 20, wherein the cantilever is tapered in at least one
30 dimension such that the fixed end is larger than the free end in said at least one dimension.

1 26. (Original) The apparatus of Claim 20, wherein a dimension of the cantilever varies from
2 the fixed end to the free end to determine vibrational characteristics of the cantilever.

3 27. (Original) The apparatus of Claim 20, wherein the cantilever is formed by at least one of
4 a deep reactive ion etching, a photolithography, an electron beam lithography, and a wet anisotropic
5 etching of the substrate using a mask to define a shape of the cantilever.

6 28. (Currently Amended) The apparatus of Claim 20, wherein the cantilever comprises one
7 of:

8 (a) an emitting waveguide that receives the light at the fixed end and directs the
9 light received to the free end, where the light is emitted for illuminating the target;

10 (b) a receiving waveguide that receives light that is reflected from the target
11 through the free end and directs the received light to the fixed end for detection by a the photon
12 detector; and

13 (c) a flexible member that supports the light source.

14 29. (Previously Presented) The apparatus of Claim 20, wherein the cantilever is one of:

15 (a) deflected into a resonant motion in at least one of two directions;

16 (b) deflected into a non-resonant motion in at least one of the two directions;

17 (c) deflected into two-dimensional circular motion using single actuator;

18 (d) deflected into two-dimensional rocking linear motion using single actuator;

19 and

20 (e) deflected so as to selectively move the free end to a desired position.

21 30. (Original) The apparatus of Claim 20, wherein the actuator comprises one of an
22 electrostatic force actuator, a piezoelectric actuator, and a magnetic actuator.

23 31. (Original) The apparatus of Claim 20, wherein the actuator comprises at least one of:

24 (a) an actuator for deflecting the cantilever in a vertical direction relative to a
25 primary plane of the substrate; and

26 (b) an actuator for deflecting the cantilever in a horizontal direction relative to the
27 primary plane of the substrate.

28 32. (Original) The apparatus of Claim 20, wherein the actuator is attached to at least one of:

29 (a) the cantilever; and

30 (b) the substrate.

1 33. (Previously Presented) The apparatus of Claim 20, wherein the position sensor comprises
2 one of:

- 3 (a) the actuator;
- 4 (b) a piezoelectric transducer;
- 5 (c) a capacitive displacement transducer;
- 6 (d) a piezoresistive sensor;
- 7 (e) a light source and detector pair;
- 8 (f) a photodetector array;
- 9 (g) a magnetic sensor;
- 10 (h) a fiber bundle displacement sensor;
- 11 (i) an interferometer; and
- 12 (j) an inductive displacement transducer.

13 34. (Original) The apparatus of Claim 20, further comprising a lens disposed at the free end
14 of the cantilever through which the light conveyed through the cantilever passes.

15 35. (Original) The apparatus of Claim 34, wherein the lens comprises one of a focusing lens,
16 a refractive lens, and a diffractive lens.

17 36. (Original) The apparatus of Claim 34, wherein the free end of the cantilever comprises a
18 gradient index lens.

19 37. (Canceled)

20 38. (Currently Amended) The apparatus of Claim ~~37~~ 20, wherein the photon detector is
21 supported by one of the substrate and the cantilever, ~~the photon detector detecting the emitted light~~
22 ~~that is reflected from the target.~~

23 39. (Currently Amended) The apparatus of Claim ~~37~~ 20, wherein the photon detector is
24 disposed at one of:

- 25 (a) adjacent to the free end of the cantilever, to detect light emitted from the free
26 end of the cantilever that has been reflected from the target;
- 27 (b) adjacent to the fixed end of the cantilever, to detect light that has been received
28 from the target at the free end of the cantilever and conveyed to the fixed end of the cantilever; and
- 29 (c) on the free end of the cantilever, to detect light emitted from the free end of the
30 cantilever that has been reflected from the target.

1 40. (Original) The apparatus of Claim 20, further comprising a controller that causes the
2 actuator to drive the free end of the cantilever in a pattern relative to the target, so as to do one of:

3 (a) display an image on the target; and

4 (b) acquire an image of the target.

5 41. (Original) The apparatus of Claim 20, further comprising at least one of:

6 (a) a tapered waveguide coupler optically coupling the light source to the
7 cantilever; and

8 (b) an index-matching material optically coupling the light source to the
9 cantilever.

10 42. (Original) The apparatus of Claim 20, further comprising a flexible sheath enclosing the
11 light source, substrate, cantilever, actuator, and position sensor, so that the apparatus is usable as an
12 endoscope.

13 43. (Currently Amended) A method for enabling either a far-field image acquisition or a
14 display of an image, in regard to a limited region of interest, using a micro-electro-mechanical system
15 (MEMS), comprising the steps of:

16 (a) forming a cantilever on a substrate;

17 (b) removing a portion of the substrate underlying the cantilever;

18 (c) supporting the cantilever at a fixed end of the cantilever, the fixed end
19 remaining fixed to the substrate, a free end of the cantilever extending freely beyond where the
20 portion of the substrate was removed from supporting the cantilever, enabling the free end to bend
21 and deflect relative to a target in the limited region of interest, for scanning the target;

22 (d) bending and deflecting the cantilever so as to move the free end in a desired
23 motion to scan the target; and

24 (e) receiving light at a location that is proximate to the cantilever and to the
25 support; and

26 (f) detecting a position of the free end of the cantilever, producing a signal
27 indicative of the position for use in controlling the cantilever to move in the desired motion.

28 44. (Original) The method of Claim 43, wherein the cantilever has at least two dimensions
29 that are smaller than one millimeter.

30 ///

1 45. (Original) The method of Claim 43, further comprising one of the steps of:

2 (a) end-butting a light source to the fixed end of the cantilever; and

3 (b) attaching a light source adjacent to the free end of the cantilever.

4 46. (Original) The method of Claim 43, further comprising the step of tapering the cantilever
5 in at least one dimension, such that the fixed end is larger than the free end in said at least one
6 dimension.

7 47. (Original) The method of Claim 43, further comprising the step of forming the cantilever
8 by at least one of a deep reactive ion etching and a wet anisotropic etching of the substrate using a
9 mask to define a shape of the cantilever.

10 48. (Previously Presented) The method of Claim 43, further comprising at least one of the
11 steps of:

12 (a) receiving light at the fixed end and directing the light received to the free end,
13 said cantilever acting as a waveguide, said free end emitting light to illuminate the target;

14 (b) receiving light that is reflected from the target through the free end and
15 directing the light that is received to the fixed end for detection by a photon detector; and

16 (c) supporting a light source at the free end, said light source emitting light that
17 illuminates the target.

18 49. (Original) The method of Claim 43, wherein the step of deflecting comprises one of the
19 steps of:

20 (a) deflecting the cantilever into a resonant motion in at least one of two
21 orthogonal directions; and

22 (b) deflecting the cantilever so as to selectively move the free end to a desired
23 position.

24 50. (Original) The method of Claim 43, where the step of deflecting comprises at least one
25 of the steps of:

26 (a) deflecting the cantilever in a vertical direction relative to a primary plane of the
27 substrate; and

28 (b) deflecting the cantilever in a horizontal direction relative to the primary plane
29 of the substrate.

30 ///

1 51. (Previously Presented) The method of Claim 43, wherein the step of sensing the position
2 of the cantilever is done with one of:

3 (a) an actuator, when the actuator is not being employed for driving the cantilever
4 to move in the desired motion;

5 (b) a piezoelectric transducer;

6 (c) a capacitive displacement transducer;

7 (d) a piezoresistive sensor;

8 (e) a light source and detector pair;

9 (e) a photodetector array;

10 (f) a magnetic sensor;

11 (g) a fiber bundle displacement sensor;

12 (h) an interferometer; and

13 (j) an inductive displacement transducer.

14 52. (Original) The method of Claim 43, further comprising the step of focusing light
15 transmitted through the free end of the cantilever.

16 53. (Original) The method of Claim 52, wherein the step of focusing light is done with one
17 of:

18 (a) a refractive lens;

19 (b) a diffractive lens; and

20 (c) a gradient index lens formed at the free end of the cantilever.

21 54. (Original) The method of Claim 43, further comprising the step of detecting light that is
22 reflected from the target.

23 55. (Previously Presented) The method of Claim 54, wherein the step of detecting the light is
24 carried out with one of:

25 (a) a light sensor that is disposed adjacent to the free end of the cantilever, to
26 detect light emitted from the free end of the cantilever that is reflected from the target; and

27 (b) a light sensor that is disposed adjacent to the fixed end of the cantilever, to
28 detect light that has been received from the target at the free end of the cantilever and conveyed to the
29 fixed end of the cantilever.

30 ///

1 56. (Previously Presented) The method of Claim 43, wherein the step of deflecting the
2 cantilever comprises the step of driving the free end of the cantilever to move in a pattern relative to
3 the target so as to do one of the steps of:

- 4 (a) displaying an image on the target; and
- 5 (b) acquiring an image of the target.

6 57. (Original) The method of Claim 43, further comprising at least one of the steps of:

- 7 (a) coupling a light source to the fixed end of the cantilever through a tapered
8 waveguide coupler; and
- 9 (b) coupling a light source to the fixed end of the cantilever with an
10 index-matching material.

11 58. (Original) The method of Claim 43, further comprising the step of enclosing at least the
12 substrate and the cantilever in a flexible sheath to function as an endoscope.